

Enhancing Literacy and Numeracy: Developing Snakes and Ladders Oriented Toward Higher Order Thinking Skills

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Abstract

This research aims to develop learning media for the snake and ladder game oriented toward higher-order thinking Skills (HOTS) to enhance literacy and numeracy in elementary schools. The method used is Research and Development (R&D) with the ADDIE model. The subjects of this research are fifth-grade students. The instruments include validation sheets for content and design experts and teacher and student response questionnaires. Instrument testing was conducted using a feasibility validity test. Data collection techniques involve document analysis, observation, interviews, questionnaires, and tests. Data analysis was performed using descriptive analysis and descriptive statistics. The results show that the snake and ladder media received a validation score of 0.91 from content experts and 0.93 from design experts. Teacher responses scored 0.94, while student responses reached 0.93, indicating excellent criteria. This media also enhanced students' literacy and numeracy skills, with average scores of 69.22 in Cycle 1 and 85.55 in Cycle 2. Based on these results, improving game features and increasing the variety of HOTS questions is recommended.

Keywords: *learning media; snakes and ladders; literacy; numeracy; HOTS; Merdeka Curriculum.*

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Introduction

The Ministry of Education and Culture has gradually implemented the Merdeka Curriculum since 2022 in an effort to improve the quality of education in Indonesia. This curriculum provides a range of intra-curricular learning experiences with streamlined content, allowing students more time to delve into concepts and enhance their skills (Arwitaningsih et al., 2023). The implementation of the Merdeka Curriculum places responsibility on schools to enhance learning outcomes by adhering to the standard learning processes, principles, and assessments outlined within the curriculum (Mulyasa, 2023).

One crucial aspect of the Merdeka Curriculum is the development of students' literacy and numeracy, which involves not only mastering basic skills in reading, writing, and arithmetic but also cultivating higher order thinking skills (HOTS). Badjeber & Purwaningrum (2018) state that the application of HOTS in the learning process emphasizes students' abilities to think critically, analytically, and creatively. This aligns with the goals of the Merdeka Curriculum to produce competent and adaptable graduates (Cholilah et al., 2023). According to Laksana (2024) The improvement of literacy skills, both reading and writing, and numeracy

skills (mathematics) in primary education is crucial to ensure that students have strong foundational skills to meet current global demands.

Despite the introduction of the Merdeka Curriculum, traditional teaching media in Indonesian classrooms often fail to engage students effectively, relying heavily on rote learning and basic skills. This gap highlights the need for innovative approaches that integrate Higher Order Thinking Skills (HOTS) to develop critical, analytical, and creative abilities. Sälzer & Roczen (2018) The current educational practices do not sufficiently prepare students for global challenges, as evidenced by low PISA scores in literacy and numeracy.

Research by Wahid & Karimah (2018) indicates that HOTS can be incorporated by motivating students to explore multiple alternative answers or solutions. HOTS can also be integrated by encouraging students to use their creativity to draw their own conclusions.. Research by Zebua (2024) demonstrates that integrating HOTS into learning enhances students' abilities to solve problems, analyze information, and make critical and creative decisions. This suggests that incorporating HOTS into educational practices can effectively develop students' cognitive skills necessary for navigating complex challenges and making informed judgments. According to Wilson (2016), activities such as analyzing (C4), evaluating (C5), and creating (C6) fall under the category of HOTS. Therefore, if the goal of learning is to enhance literacy and numeracy skills, the context and learning materials need to be structured in a way that supports learning focused on HOTS. This method encourages students to progress critical and creative thinking skills essential for addressing global demands effectively.

Integrating HOTS into learning is essential to enhance students' cognitive skills, enabling them to analyze, evaluate, and create solutions to complex problems (Kwangmuang et al, 2021). Here's a paraphrase of your sentence: The advancement of innovative learning methods to improve higher-order thinking skills among junior high school students in Thailand. *Heliyon*, 7(6).By emphasizing these skills, the Merdeka Curriculum aims to cultivate adaptable graduates. Therefore, innovative media like the snakes and ladders game can foster an engaging learning environment, motivating students while aligning with the global educational standards necessary for effective literacy and numeracy development. This research will address these gaps by focusing on the integration of HOTS through enjoyable and practical learning tools, ultimately enhancing educational outcomes.

Based on the survey data from the PISA study in 2018, it is evident that Indonesian students scored 371 in reading literacy, while the OECD average was 487. Indonesian students scored 379 on the maths exam on average, compared to the OECD average of 487. Compared to the OECD average of 489, Indonesian students scored an average of 389 for science literacy (Gurría, 2019). These PISA results underscore the necessity of educators to provide comprehension experiences that support students' learning needs in achieving literacy and numeracy proficiency.

Teachers are encouraged to choose instructional materials with greater creativity and innovation under the Merdeka Curriculum. Teaching media plays a crucial role in supporting effective learning processes. Instructors possess the liberty to select from an assortment of pedagogical resources customized to the requirements and inclinations of their pupils (Pertiwati et al., 2023). Consequently, it's critical that educators figure out how to ensure that learning is both effective and engaging for students, avoiding confusion (Marisa, 2021). Inappropriate use of teaching media can make lessons less interesting and boring (Rahmawati et al., 2022). An essential component of the educational landscape is the function that instructional media play in the process of teaching and learning (Junaidi, 2019). Teaching media has the ability to convey messages to recipients with the aim of stimulating thinking, emotions, focus, and enthusiasm for the educational process (Tafonao, 2018). Thus, teaching media can be seen as a tool that explains several learning concepts comprehensively, which may be difficult to explain verbally (Putra, 2021).

Based on observations at elementary school 44 Bengkulu city's 5th-grade class, it has been found that the scores for Minimum Competency Assessment (AKM) remain low nationwide. This issue arises because literacy and numeracy teaching activities conducted by classroom teachers in reading and arithmetic still rely on conventional teaching media. Teachers write materials on the blackboard and explain them orally with the aid of printed books. To address this issue, innovation in teaching media is necessary to enhance literacy and numeracy skills for Phase C students. Furthermore, the questions prepared by teachers do not fully align with the criteria for HOTS appropriate for students' cognitive thinking levels.

One suitable teaching media innovation is the snakes and ladders game. Based on research by Fachrudi et al (2024), the use of snakes and ladders as a teaching media can enhance students' literacy and numeracy skills while maintaining their interest. Through enjoyable gameplay as a teaching medium, Throughout the learning process, kids are not bored and more motivated to actively participate in learning.

The snakes and ladders game is already popular in society, making it easy to introduce to students. Advantages of the snakes and ladders game include enhancing cognitive abilities and being practical, economical, and easy to play (Yudiyanto et al., 2022). According to Royani & Suryana (2023), the snakes and ladders game can serve as an alternative process to motivate active student participation. Fransisca et al. (2020) found that self-confidence significantly improves through participation in snakes and ladders activities. Research by Winarni et al. (2023) indicates that using the word recognition game snakes and ladders has a lot of potential as a powerful and entertaining learning aid.

The snakes and ladders game has proven effective as a learning tool because it integrates gameplay elements with educational content, thereby enhancing student motivation and engagement in learning. Students benefit from using instructional material in the learning process achieve better understanding and enhances their motivation to learn, thereby achieving optimal learning outcomes (Wardani et al., 2024). By utilizing the snakes and ladders game, The goal of this study is to create game-based educational materials specifically designed to promote literacy and numeracy skills based on Higher Order Thinking Skills (HOTS) within the context of the Merdeka Curriculum.

Methodology

This research adopts a development research or Research & Development (R&D) approach. According to Sugiyono (2021), R&D method is used to investigate, design, produce, and validate the resulting product. R&D is a procedure or series of actions to create new products or enhance current ones to ensure accountability (Winarni, 2018). The R&D process typically involves five stages known as ADDIE: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The adaptation of the ADDIE model stages for product development is illustrated in Figure 1.

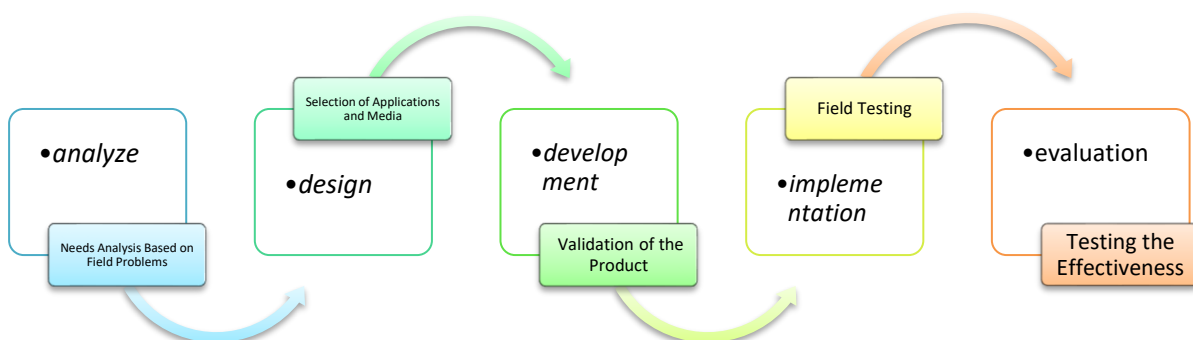


Figure 1. Stages of Product Development Adaptation from the ADDIE Model

Analysis

A needs analysis is conducted to identify specific issues to be addressed through the learning media. Data is collected through surveys, interviews, and observations to understand the current conditions, student needs, and shortcomings in existing teaching methods.

Design

Learning objectives are clearly defined, including the development of content and the structure of the snake and ladder game. A lesson plan is created to integrate Higher Order Thinking Skills (HOTS) into the activities.

Development

The learning media is designed and produced based on the established design. A prototype of the snake and ladder game is developed, complete with usage guidelines and assessment tools.

Implementation

The media is tested in the classroom. Students are given the opportunity to play and learn using the media, while the teacher observes to record its effectiveness.

Evaluation

Evaluation is conducted at two levels: pretest and posttest. Feedback from students and teachers is collected to assess the effectiveness of the media and inform further improvements.

This research was conducted from April to June 2024 with student subjects from Phase C, Grade 5, at elementary school 44 Bengkulu City. There were 20 students in class 5A and 20 students in class 5B who participated in this study. Instruments used included questionnaires for Content Experts and Design Experts, as well as a questionnaire to assess comments from students to the game-based learning materials for Snakes and Ladders. Instrument validity was tested by comparing the instrument content with relevant theories. The purpose of the response questionnaire was to evaluate user feedback on the developed educational material based on the game Snakes and Ladders.

The study and development of the game-based learning media for reading and numeracy, Snakes and Ladders employed data collecting methodologies focusing on HOTS questions within the Merdeka Curriculum, included: 1) Document Analysis, 2) Observation, 3) Questionnaire, and 4) Test.

Descriptive statistical analysis and descriptive analysis were the data analysis methods used in this investigation. Based on the outcomes of validation tests and small-scale trials, notes, recommendations, and comments from experts (validators) on the learning media based on the game of snakes and ladders were managed using qualitative descriptive analysis. The snakes and ladders game-based learning media package was revised based on this analysis. Data, including expert validation ratings and questionnaire responses from respondents, were analyzed using descriptive statistical analysis. Aiken's formula served as the foundation for the validity formula (Azwar, 2015):

$$V = \frac{\sum S}{[N(c-1)]}$$

Explanation of Aiken's V Formula:

V	:	Aiken's V index of content validity
S	:	Score assigned by each rater minus the lowest score in the category ($s = r - lo$)
Lo	:	Lowest validity rating score (e.g., 1)
C	:	Highest validity rating score (e.g., 4)
N	:	Number of raters

Based on the calculated *V* index, each item or instrument can be categorized according to its index value, as shown in Table 1.

Table 1. Index and Criteria of Content Validity

Range of Content Validity Index	Validity Criteria
$V \leq 0,4$	Weak
$0,4 < V < 0,8$	Moderate
$V \geq 0,8$	High

(Source: Azwar, 2015)

The summarized scores from the questionnaire are then calculated to obtain their percentages using the formula:

$$P = \frac{A}{B} \times 100\%$$

Explanation:

P	=	Percentage of	
A	=	Total score obtained	
B	=	Ideal total score	

Interpretation and decision-making regarding the quality of product development are carried out by considering validity based on the criteria listed in Table 2.

Table 2. Criteria for User Responses of the Snakes and Ladders Game Media

Presentase	Keterangan
81 % - 100 %	Very Good
61 % - 80 %	Good enough
41 % - 60 %	Less Good
< 40 %	Not Good

(Source: Sugiyono, 2015)

Results and Discussion

Based on the data collected, the results and analysis include two formulated research problems as follows:

Development of Snakes and Ladders Game-Based Literacy and Numeracy Media with HOTS

Research and development among the instructional resources based on the game Snakes and Ladders were conducted through five stages based on the ADDIE model. The first stage is Analysis, where information is gathered to understand the needs and objectives of the product. The second stage is Design, involving the creation of product designs and development strategies based on the analysis results. The third stage is Development, where the actual product is created based on the previously planned design. The Implementation stage is the fourth, where the product is introduced to elementary schools or end users. The final stage is Evaluation, where the product is evaluated to measure its effectiveness according to predefined goals. By following this model, the research and development process can be conducted systematically and efficiently to achieve desired outcomes. The following description of the research and development results is presented below.

Analysis

Within the evolution stage of the snakes and ladders game media, an analysis of needs was conducted to determine the type of learning media necessary to support students' learning processes. This analysis consisted of two main steps: curriculum analysis and needs analysis.

The curriculum analysis sought to ascertain the materials to be included in the instructional device. Meanwhile, the needs analysis was conducted at Elementary School 44 Bengkulu City through observations and interviews with teachers and several students. The goal was to identify major issues experienced during the education process.

From the needs analysis, it was found that the learning process was perceived as uninteresting by students because teachers only delivered materials according to the textbooks. Students also felt that the learning was less interactive and boring, often receiving questions without comprehensive explanations. This led to difficulties in literacy and numeracy activities, with the majority of students showing little interest in activities such as writing, reading, and arithmetic.

Design

Designing the Snakes and Ladders Game Based on the Following Analysis.

Instrument Creation

- a. Instrument Validation: The instruments created were validated by subject matter experts and instructional design experts to ensure accuracy and alignment with the learning objectives.
- b. Assessment of Student Responses: Student responses to the game media will be assessed using questionnaire sheets to measure their understanding and level of engagement.
- c. Development of HOTS Questions: Higher Order Thinking Skills (HOTS) based questions are crafted to ensure that the game encourages critical and analytical thinking among students.

Development of Literacy and Numeracy Snakes and Ladders Game Media

The researcher designed learning modules to ensure a structured and clear learning process. Two types of modules were developed: a control class module, routinely used by 5th-grade teachers, and an experimental module used by researchers for implementation.

Design Determination

Before finalizing the design, the researcher gathered all elements of the media for the Snakes and Ladders game and summarized literacy and numeracy content to be included in the media. The learning medium for the snakes and Ladders game has the following design:

- a) Game Instructions using Canva Application: Game instructions were created using the Canva application to provide clear guidance to students,
- b) Design of Sequential Board Boxes and Number Boxes using Canva Application: Canva was used to design the game board with sequential boxes and visible numbers,
- c) Creation of Snake and Ladder Images using Canva Application: Images of snakes and ladders were created using Canva to enhance visual appeal,
- d) Selection of High-Contrast Colors using Canva Application: Canva was used to select contrasting color combinations for better visual understanding and appearance of the game board,
- e) Creation of HOTS Practice Question Cards: HOTS-based question cards were prepared to motivate students in solving problems more deeply,
- f) Creation of Snakes and Ladders Dice with Panel Cloth: Dice for the snakes and ladders game were made using panel cloth for safety and practicality,
- g) Compilation of Content Material Included in Snakes and Ladders Media: Relevant literacy and numeracy content was organized and incorporated into the snakes and ladders game media to ensure strong integration between learning and gameplay.

Below is the design display of the printed instructional materials for the Snakes and Ladders game shown in Figure 2.



Figure 2. Printed Snakes and Ladders Game Media

Development

During the progres phase, developed product was handed over to validators who are experts in the aspects of content and design for validation. The researcher provided the learning media product along with validation instruments to all validators. After the validators evaluated the snakes and ladders game media product, researcher met with each validator to listen to their suggestions and feedback aimed at enhancing the quality of the snakes and ladders game learning media.

Validation Results of Content

The literacy and numeracy snakes and ladders learning media were validated by 2 validators specializing in language and mathematics. Using Aiken's V Index, a summary of the content validation findings from both validators is shown in Table 3.

Table 3. Content Validation Results

Item Number	Validator 1		Validator 2		$\sum S$	V	Kategori
	Score	S	Score	S			
1	4	3	4	3	6	1	High
2	3	2	4	3	5	0.8	High
3	4	3	4	3	6	1	High
4	4	3	4	3	6	1	High
5	4	3	4	3	6	1	High
6	4	3	4	3	6	1	High
7	4	3	4	3	6	1	High
8	4	3	3	2	5	0.8	High
9	4	3	4	3	6	1	High
10	4	3	4	3	6	1	High
11	4	3	4	3	6	1	High
12	4	3	3	2	5	0.8	High
13	4	3	3	2	5	0.8	High
14	4	3	3	2	5	0.8	High
15	3	2	3	2	4	0.6	Moderate

The content validation results in Table 3 indicate that the Aiken's V Index has an average score of 0.91, indicating a high level of validity. The instrument's reliability was calculated using Interreter Reliability, resulting in a material validity reliability of 73%, which can be categorized as strong criteria.

Design Validation Results

The HOTS question-based literacy and numeracy snakes and ladders game media product was assessed by 2 expert validators with Educational Technology and Design qualifications. A recapitulation of design validation from the results of the Aiken's V Index for both validators is shown in Table 4.

Table 4. Design Validation Results

Item Number	Validator 1		Validator 2		ΣS	V	Category
	Score	S	Score	S			
1	4	3	4	3	6	1	High
2	4	3	4	3	6	1	High
3	4	3	4	3	6	1	High
4	4	3	4	3	6	1	High
5	4	3	4	3	6	1	High
6	4	3	4	3	6	1	High
7	4	3	4	3	6	1	High
8	4	3	3	2	5	0.8	High
9	4	3	4	3	6	1	High
10	4	3	4	3	6	1	High
11	4	3	4	3	6	1	High
12	4	3	4	3	6	1	High
13	4	3	3	2	5	0.8	High
14	4	3	3	2	5	0.8	High
15	3	2	3	2	4	0.6	Moderate

The design validation results in Table 4 show that the Aiken's V Index has an average score of 0.93, indicating a high level of validity. The instrument's reliability was calculated using Interreter Reliability, resulting in a strong design reliability of 80%.

Results of Student Responses to Snakes and Ladders Media Literacy and Numeracy

The response test is carried out to find out whether the product is good or not for potential users, namely teachers and students. The reaction test results are summarized as follows, and they may be explained as follows.

Teacher Response

The first response from the teacher was taken by giving a questionnaire to two grade 5 instructors at Bengkulu City's Elementary School 44. The table displays the instructor reaction test results in 5.

Table 5. Teacher Response Results

Indicator	Teacher 1	Teacher 2	Criteria
Attractiveness	0.91	0.91	Very Good
Content	0.94	0.95	
Design	0.93	0.95	
Literacy	0.93	0.93	
Numeracy	0.95	0.95	
HOTS	0.96	0.96	
Average Score	0.94	0.94	

Table 5 shows that the teachers who took part in the trial's product reaction had an average score of 0.94, which is classified as "Very Good".

Student Response

The instructional resources for snakes and ladders product which had been revised based on expert validation was administered to 20 pupils in class 5 A and 20 pupils in class 5 B at SD Negeri 44 Bengkulu City as research subjects. On June 3, 2024, student answers to the instructional materials were collected for this study. Table 6 displays the responses that students gave to the learning materials for the literacy and numeracy game Snakes and Ladders.

Table 6. Student Response Results

Indicator	Average Score	Criteria
Attention	0.90	Very Good
Interest	0.93	
Confidence	0.91	
Satisfaction	0.95	
Average Score	0.93	

Based on Table 6, the results of the product response obtained from the students involved in the trial received an average score of 0.93, categorized as "Very Good".

Effectiveness of the Development of Literacy and Numeracy Snake and Ladder Media Implementation

The effectiveness of the product development is measured through implementation activities to assess the efficiency of the media in accomplishing educational goals, especially in terms of literacy and numeracy for students. The application of the product is executed using the Classroom Action Research (CAR) method with two cycles.

The implementation phase begins with planning. Planning involves coordination with the 5th grade teachers who are responsible for implementing the learning media in the classroom. Once the researcher and teachers agree on the schedule, they proceed with the lessons using the literacy and numeracy snake and ladder game based on HOTS (Higher Order Thinking Skills). The teachers act as instructors and facilitators of learning, while the researcher observes and documents the process. The lessons are conducted using the media that follows the steps of the snake and ladder game.



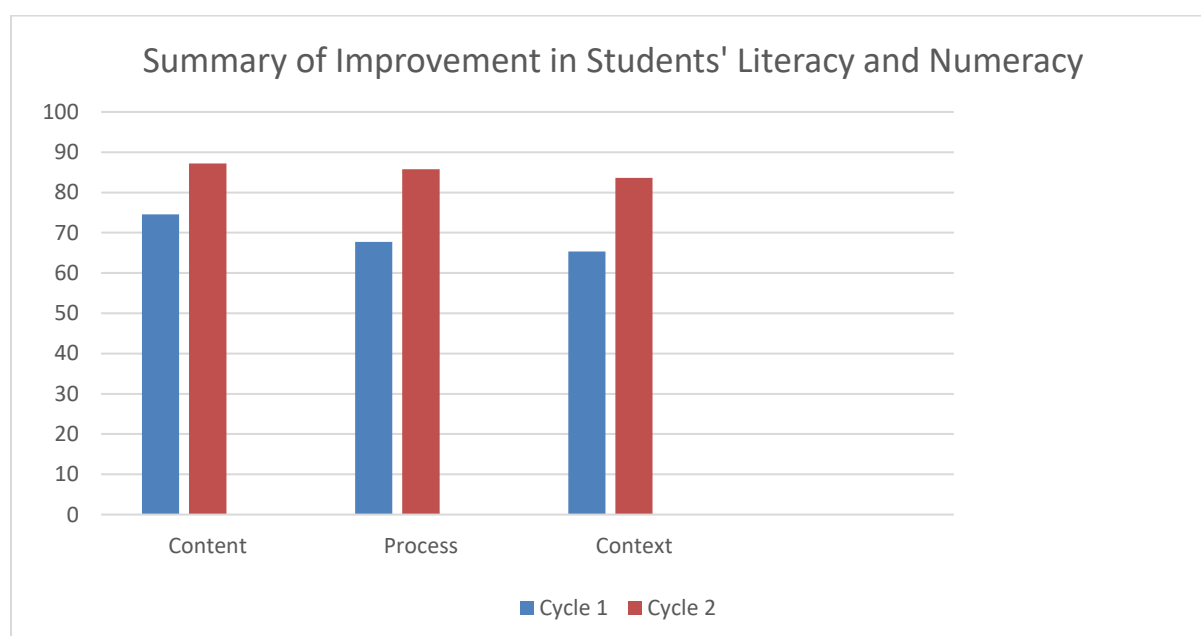
Figure 3. Students Working on HOTS Problems

After conducting the actions by applying the learning media in two cycles, students are assessed using a self-assessment questionnaire in each cycle. This questionnaire is used to evaluate students' literacy and numeracy after participating in the lessons. The results of the literacy and numeracy tests for students are displayed in Table 7.

Table 7. Results of Literacy and Numeracy Tests for Students

Indicator	Test Results	
	Cycle 1	Cycle 2
Content	74.59	87.23
Process	67.73	85.80
Context	65.33	83.63
Average Score	69.22	85.55

Based on Table 7, there is an improvement in students' literacy and numeracy from Cycle 1 to Cycle 2. The average increase in literacy and numeracy is 16.33. A summary of the enhancement of pupils' literacy and numeracy can be seen in Graph 1.



Graph 1. Summary of Improvement in Students' Literacy and Numeracy

Students' reading and numeracy abilities have significantly improved, as shown by Graph 1. Therefore, it can be concluded that the application of the literacy and numeracy snake and ladder game based on Higher Order Thinking Skills can enhance students' literacy and numeracy.

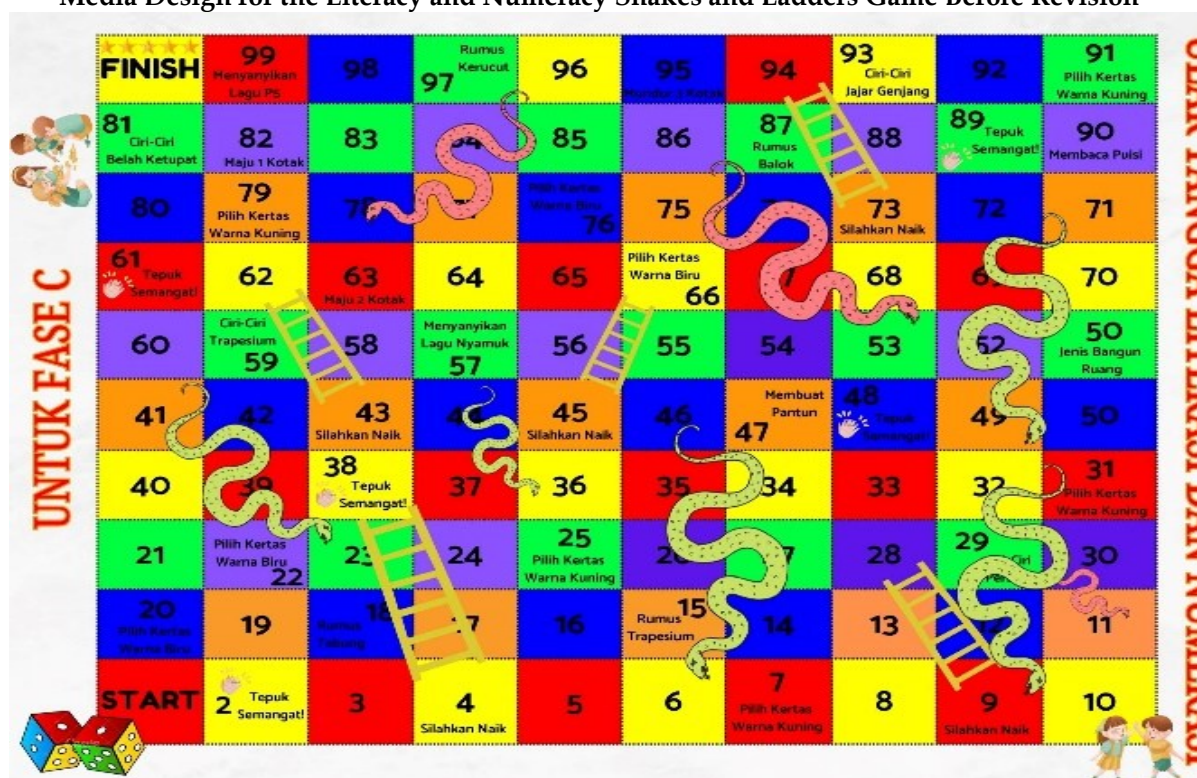
The results of the study indicate that the use of HOTS-based snake and ladder learning media significantly enhances students' literacy and numeracy skills. According to Riyadi & Zulfiati (2024), students learn more effectively when they engage in activities that promote exploration and discovery, which is reflected in this game-based approach. The snake and ladder game creates an enjoyable learning environment that can boost students' motivation to learn. Research by Nasution et al. (2024) indicates that intrinsic motivation plays a crucial role in effective learning.

Evaluation

Evaluation involves refining the developed product after going through the previous stages. Product revisions are based on feedback from subject matter experts, designers, responses from teachers and students, and the outcomes of actions during the implementation phase. The results of revisions to the literacy and numeracy snake and ladder game are presented in Figure 4.



Media Design for the Literacy and Numeracy Snakes and Ladders Game Before Revision



Media Design for the Literacy and Numeracy Snakes and Ladders Game After Revision

Figure 4. Results of Revised Literacy and Numeracy Snake and Ladder Game

Snake and ladder game media is an appropriate choice for integrating literacy and numeracy education (Sulistiyorini & Sumajaya, 2024). The development of this instructional media leverages Bloom's Taxonomy to enhance students' literacy and numeracy skills. According to Susanti et al. (2023) literacy educational media can be integrated with the surrounding environment as a form of concrete knowledge that has the potential to enhance elementary school students' literacy. Education should emphasize essential skills that envision modern life in the future (Darmansyah et al., 2023). According to Izzatin et al (2022) HOTS questions encompass cognitive levels such as analyzing, evaluating, and creating, which play a role in enhancing students' literacy and numeracy abilities.

Research by Patriana et al (2021) suggests strategies for integrating literacy and numeracy into curricular activities through the development of HOTS questions and designing enjoyable educational media for students. Findings from Ariffiando et al (2024) demonstrate that the development of high-level thinking skills can be enhanced through engaging educational media. Singh et al (2023) state that students with high literacy and numeracy skills tend to experience better development and can contribute positively to their environment. Therefore, literacy and numeracy are essential components in preparing students for the future.

Conclusion

The research and development of the snake and ladder game oriented towards Higher Order Thinking Skills (HOTS) for enhancing literacy and numeracy in the Merdeka Curriculum for elementary schools indicate that this media is highly suitable for use. It received a validation score of 0.91 from content experts and 0.93 from design experts. The teacher responses averaged 0.94, while students rated it 0.93, indicating excellent criteria. The snake and ladder media also proved effective in improving kids' proficiency in reading and math, with average scores of 69.22 in Cycle 1 and 85.55 in Cycle 2. Applying the ladder and snake game in learning has several practical implications, including enhancing student motivation by creating a more engaging and interactive classroom environment. Additionally, this game aids in developing literacy and numeracy skills. By integrating HOTS, students can better understand literacy and numeracy concepts. Recommendations from this study include developing additional features for the game, such as a wider variety of questions and adjustable difficulty levels tailored to students' abilities. Conducting trials with different age groups, including students from various educational levels, will also be valuable for evaluating the efficiency of this medium in a broader learning context. The implications of this research suggest that instructional media like the snake and ladder game can be an integral part of curriculum development focused on mastering literacy and numeracy competencies and higher-level thinking skills. This match concludes the application of the snake and ladder instructional media significantly enhances students' literacy and numeracy skills.

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